this end as the grasshopper, whose work is not so completely done. The fact that the grasshopper is constantly in sight, and his work often carried to such excess as to be injurious to man, while the cricket is mostly unseen and his work pretty much unknown, has caused the one to be branded as man's destructive enemy, while the other is unthought of, although they are co-laborers in the same field, both literally and figuratively.

It is a point of some interest to find that the larva of a species of dragon-fly possesses a gizzard so strikingly like that of the cockroach that the chief difference seems to be that while the cockroach's gizzard has six teeth that of the dragon-fly larva has but four. Yet the food of this larva is soft-bodied larva and flies, and the crop often contains the entire eyes of small insects, in a condition suitable for immediate mounting in glycerine.

THE PREPARATION AND MOUNTING OF DOUBLE STAININGS.

BY C. C. MERRIMAN.

There is no art of the microscopist more beautiful and interesting than that of bleaching and re-coloring vegetable tissues. In no other way can the wonderful process of plant growth be made manifest under the microscope. Therefore, any suggestions tending to simplify the art and make it more generally practicable will be of interest to all workers in microscopic preparations. In my experiments with double staining I have found that different colors, or at least different pigments, vary greatly in the activity or penetrating power, with which they affect vegetable substances. Thus, an object prepared for staining may be left in a strong solution of carmine for a day without having all its parts colored; whereas in a log-wood or aniline dye of equal strength it would be colored perfectly opaque in less than an hour. By taking advantage of this fact and immersing objects first in the color having the slowest action, then in another of greater activity, and so on, double, or even multiple staining becomes a simple process, instead of the very difficult and complicated one which has been published in our magazines.

I will give the general details of the operation as I have now practised it for some little time. I do not claim that exactly the same formula will answer for all kinds of plant specimens, or that all the colors given below should be used in all cases. I merely give a general formula, which each operator will find it necessary to vary somewhat according to the results of his experimenting. If I succeed in stimulating others to more detailed work, by showing how simple the process is in most cases, I will have accomplished my purpose. All vegetable preparations, whether parts of leaves or sections of stems, should first be fully decolorized in the common chlorinated soda solution, sold by all druggists as a disinfectant. This result will be accomplished in most cases in about one day. Then, after being thoroughly washed in pure water, the preparations should be placed in a solution of carmine of about the consistence of common carmine ink; and they may remain in this for a day. Pure carmine will readily dissolve in water with a few drops of aqua ammonia in it. After being washed in two or three changes of pure

water the objects may now be placed in a somewhat weaker solution of extract of logwood in alum water. A small quantity of alum in the water is sufficient to affect, at least with the aid of heat, the solution of the logwood. This should be filtered, not old at the time of use, and of a strength not more than half that of common writing ink. In this solution the objects may remain from fifteen to thirty minutes according to the delicacy of the specimens. If the color should appear to be too deep or opaque, it may be partly removed by soaking in pure alum water. Then, after washing again in several waters to remove all trace of the alum, place the objects in alcohol for a short time, and then into a weak solution of aniline blue in alcohol. In this they may remain an hour or two, or until all the parts not previously stained are colored blue. If on trial the color should appear to be too deep, it may be partially removed by soaking for a time in pure alcohol. It sometimes happens that even aniline blue will not color all the parts of vegetable substances, such as large glandular or stellate hairs. In this case an immersion for a minute or two in a very weak solution of aniline green in alcohol will accomplish the work. Green is the most powerfully absorbent color that I know of; and should be used with caution, as it would soon spoil a staining.

From alcohol the objects may be removed directly to turpentine. I do not like the action of oil of cloves. It shrivels up tender tissues and gives them the appearance of being burned. Besides it is not necessary as an intermediary between alcohol and turpentine. After a day's immersion in turpentine the preparations will be ready for mounting in Canada balsam. Vegetable preparations have quite an appreciable thickness, and unless some special care is taken of them after being mounted in balsam, it will be found that air will quite often work in under the cover. Therefore, as soon as a balsam mounting is dry enough to have the superfluous balsam cleaned off with the point of a knife, around the thin glass cover, which will be in two or three days, especially if aided by heat, a light coating of shellac cement, colored with aniline blue or red (not green or yellow,) can be spread with a camel's hair brush around the edge of the cover, and the next day another coating, and perhaps the third day another still. In this way the cover will soon be firmly set and can be cleaned; and the slide is a permanent mounting in much shorter time than if left simply for the balsam to dry hard—and there is no risk of air working in from the drying of the balsam. Canada balsam is by far the best and safest medium in which to mount all stained preparations that will bear this mounting. But there are many, such as those with delicate hairs or glands, or with fine cellular markings, that will not show to advantage in so refractive a medium as balsam. These may be removed from alcohol into water containing three or four drops of carbolic acid to the ounce of water. It will be necessary also to mount them in the same fluid in cells. Well dried shellac cells may be used; and if the tops are made perfectly level by holding a bit of fine sand-paper on them while being turned on the turn-table, the thin glass cover will fit closely, pressing out the superfluous water which can be taken up with a camel's hair brush. When well dried in this way, a little gold size can be applied to the edges with perfect safety against its running in. A very simple [illegible]ost universally applicable cell I have recently made in the following man[illegible] friend Wm. Streeter, foreman in the works of Sargeant & Greenleaf, of Rochester makes a neat little double punch for the purpose of cutting out narrow circles from the thin colored sheets of wax used by artificial flower-makers. Either

Plate I

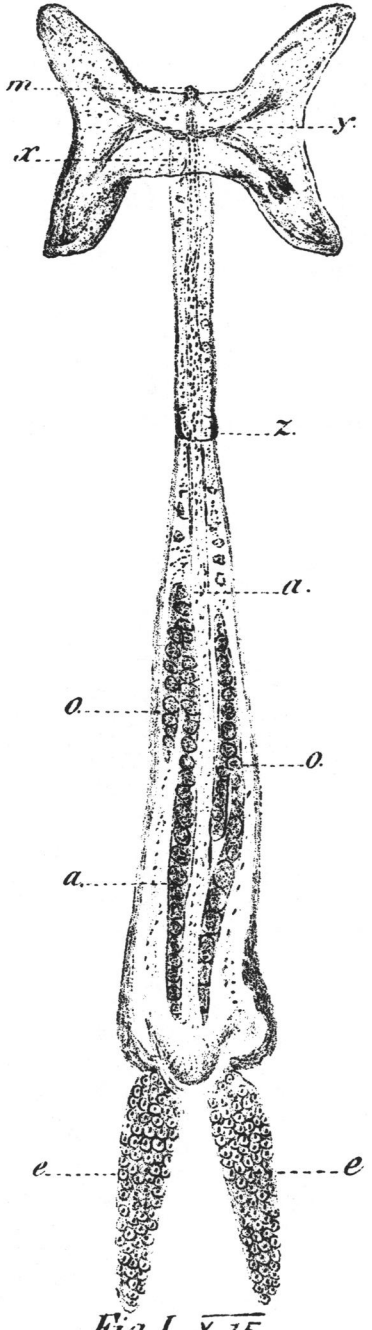

Fig. I. X 15.

Wm. B. Burford, Lith. Ind.ª

Plate 2.

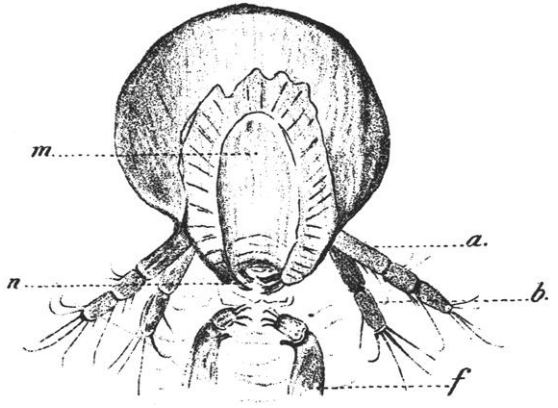

Fig. III. X 100.

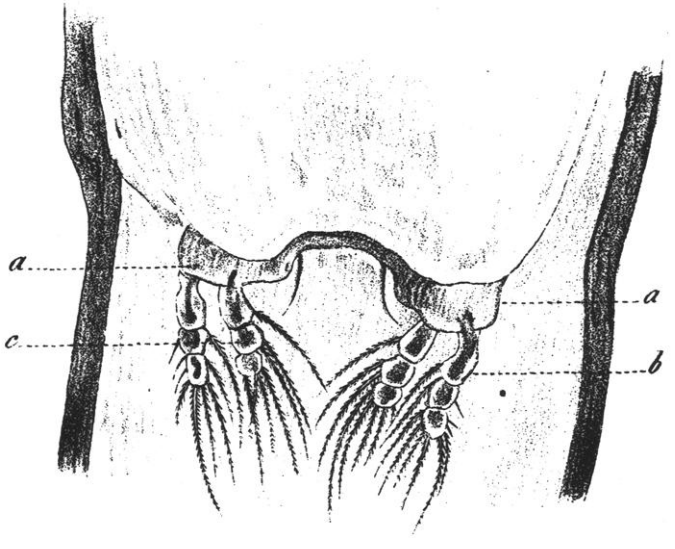

Fig. II. X 200.

Wm. B. Burford, Lith. Ind.s

single, doubled or three-folded sheets can be used, according to the thickness of cell that may be required. These circles may be fastened on the slide, either by shellac cement or by simply warming the slide. Then over all the cell, both inside and out, a coating of gold size or of marine glue dissolved in coal naptha, must be spread with a camel's hair brush. When this is dry we have a cell beautifully colored, and proof against all the fluid media which one may have occasion to use in mounting. Besides the cell is always soft enough to have the thin glass cover pressed into perfect contact with it all around, which is the great requisite in all fluid mountings. It should afterward be finished on the outside with Brunswick black or shellac cement to form a firm support to the thin glass cover.

MR. MERRIMAN'S REPLY TO THE QUESTIONS RAISED IN THE DISCUSSION OF HIS PAPER.

In answer to the objections which have been made to the use of chlorinated soda, on the ground that it is liable to destroy the structure of tender vegetable substances, I would say that if leaves are dried and pressed, or stems are first dried and then soaked before cutting into sections, they will not be injuriously affected by the soda solution. At least that has been my experience. I am informed however that there are preparations sold under the name of chlorinated soda which are imperfectly saturated with chlorine; and consequently are still strongly alkaline. These would naturally have the effect to destroy organic structures. Moreover, if this solution is exposed much to the light there is a precipitate formed and deposited, which may leave the fluid more strongly alkaline, and therefore more destructive in its effects upon vegetable tissues. The preparation known as Labarraque's fluid, imported from France, is perhaps the most reliable for bleaching purposes, though somewhat more expensive than the home-made chlorinated soda solution.

In regard to decolorizing vegetable substances by soaking in alcohol, this may be very well with thin and tender specimens, and where the object is to exhibit the cell contents; but where the object is to show the cellular structure or the fibro-vascular tissues, I think that the results will be more satisfactory in the use of the stronger chlorinated solution, which removes entirely the cell contents, and makes the specimen more transparent, and in my view far more beautiful.